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Use of BRACKISH WATER for IRRIGATION in HUMID REGIONS

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
In cooperation with the
Virginia Truck Experiment Station

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BEFORE YOU IRRIGATE WITH BRACKISH WATER IN HUMID REGIONS—

Know the salt content of the irrigation water;
Check the accumulation of salts in the soil;
Consider the salt tolerance of your crop; and
Consult your county agent, Soil Conservation Service technicians, or State Agricultural experiment station personnel if in doubt about the salt content of the soil or of the irrigation water.

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Use of Brackish Water for Irrigation in Humid Regions

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What is Brackish Water?

Brackish water may be contaminated with acids, bases, salts, or organic matter, whereas saline water contains only dissolved salts. Along the eastern seaboard, sea water is the chief contaminant of brackish water.

What Sources of Brackish Water Are Used for Irrigation?

Along the eastern seaboard, the seepage pond formed by damming up small tidal inlets is one common source of brackish water (fig. 1). Wells that are brackish either all or part of the time also supply irrigation water. In other areas, farmers use water from bays, sounds, streams, and rivers that flow into bodies of salt water and are subject to tidal fluctuations. The amount of foreign matter in these waters may vary considerably, so it is important that the water be analyzed frequently for salt content during the irrigation season. Storage reservoirs are often constructed to accumulate irrigation water

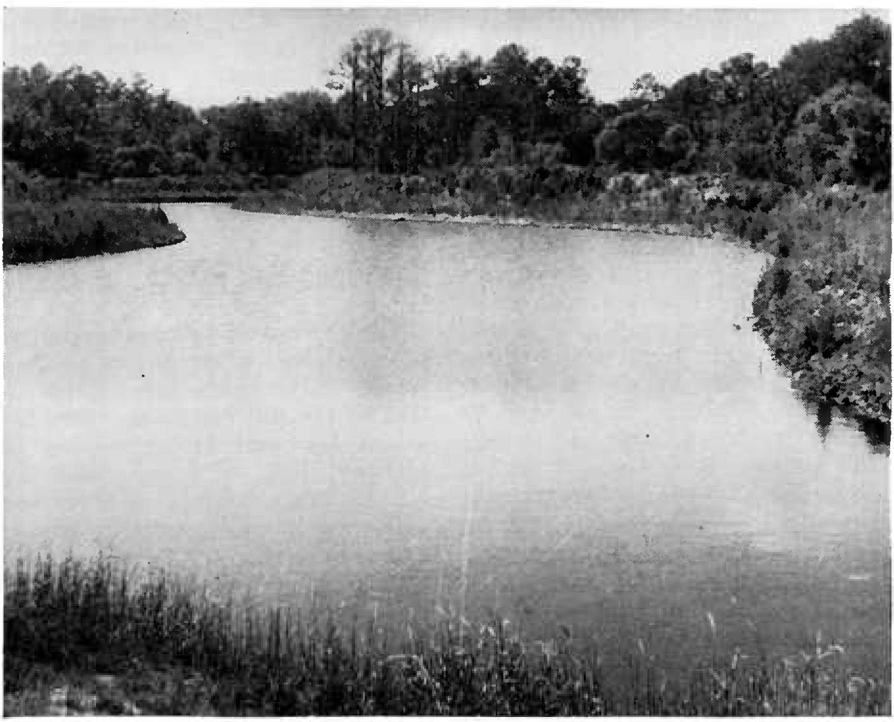

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Figure 1.—A tidal inlet that has been dammed for irrigation purposes.

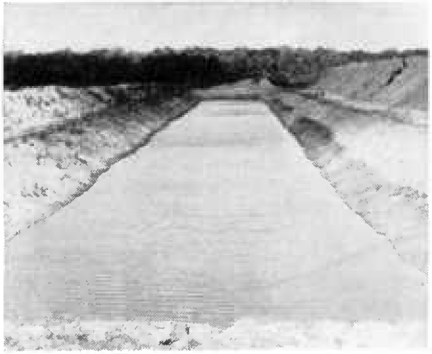

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FIGURE 2.—A storage reservoir or pond used for irrigation.

where the rate of flow of the original source is inadequate to meet peak demands (fig. 2).

How are Salts Accumulated and Removed From the Soils?

Salts may accumulate in soils of humid regions if brackish water is used for irrigation. In humid areas most irrigation water is applied by sprinkling. Owing to the limited quantity of water available for irrigation in many areas and the small amount of sprinkling equipment in use, the average single application consists of 1 to 1½ inches. As the moisture content of the soil at the time of irrigation is low, this depth of irrigation water will not penetrate the soil beyond 6 to 9 inches. Hence, if such light applications are used, salts in the irrigation water are likely to be confined to the surface foot of soil. If no rain falls between irrigations, a second irrigation will double the salt content of the surface foot.

Rainfall must more than saturate the soil to cause any appreciable leaching of salt. The amount and intensity of rainfall will determine the movement of salt in the soil profile. Light showers have little effect. In areas of relatively high rainfall, winter rains will usually leach salts out of the root zone if drainage is good. Good drainage is essential for removal of salts. Without it, the danger of salt accumulation in the surface soil is increased.

How Does Salt Accumulation Affect the Soil?

The degree to which salt will adversely affect humid area soils is still subject to further research. If large quantities of salt should accumulate in the soil, however, they may be harmful to plant growth. As the salt is leached out of the soil by rainfall, small quantities of sodium (one of the major constituents of salt present in sea water) may remain behind in an adsorbed, or tightly held, form. Should the quantity of sodium in this form accumulate in the soil in any appreciable amount, a poor physical structure will result. Soils containing relatively large quantities of adsorbed sodium are much less permeable to air and water and tend to form a hard crust when dry. Under average conditions for irrigation in humid areas, it is doubtful that adsorbed sodium will be a problem.

How Does Salt Affect the Plant?

High levels of salt accumulation in soils affect plant growth in two ways. First, as the salt concentration of the soil increases, water becomes less and less available to plants.[1] Loss of water from the soil by evaporation and plant use following brackish water irrigation causes the salt concentration of the remaining water in the soil to become greater, and thus moisture is less available. For this reason,

[1] RICHARDS, L. A. AVAILABILITY OF WATER TO CROPS ON SALINE SOILS. U.S. Dept. Agr. Agr. Inform. Bul. 210, 10 pp., illus. 1959.

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FIGURE 3.—Plots used in brackish-water studies.

plants grown on salt-affected soils require irrigation more frequently than those grown on a soil low in salt content. Plants growing under conditions of relatively high salinity are usually stunted and tend to have a bluish-green color. A reduction in growth may also occur at moderate levels of salinity in the soil, depending on the salt tolerance of the crop grown (fig. 3).

Second, plants may be affected by a direct toxicity of one or more of the constituents of the salt added by irrigation water. Toxic constituents frequently affect fruit trees, but their effect on most field and truck crops is negligible.

How Much Salt Will Crops Tolerate?

Crop growth generally decreases with increasing salinity in the soil. Some plants are more tolerant to salinity than others. Crop plants may be divided into three groups: Good salt tolerance, moderate salt tolerance, and poor salt tolerance. In the list that follows, the plants are ranked in order of decreasing salt tolerance in each crop group.

Good Salt Tolerance

Field Crops

Barley
Beets
Cotton

Forage Crops

Saltgrass
Bermudagrass
Barley hay

Vegetable Crops

Garden beets
Kale
Asparagus
Spinach

Moderate Salt Tolerance

Field Crops

Rye
Wheat
Oats
Sorghum
Corn

Forage Crops

Sweetclover
Dallisgrass
Sudangrass
Alfalfa
Tall fescue
Wheat and oat hays
Orchardgrass
Vetch

Vegetable Crops

Tomato
Broccoli
Cabbage
Potato
Lettuce
Sweet corn
Pepper
Squash
Carrot
Onion
Peas
Cucumber

Fruit Crops

Fig
Grape
Cantaloup

Poor Salt Tolerance

Field Crops

Field beans

Forage Crops

White clover
Ladino clover

Vegetable Crops

Radish
Celery
Green beans

Fruit Crops

Pear
Apple
Orange
Grapefruit
Plum
Apricot
Peach
Lemon

How is the Salinity of Irrigation Waters Determined?

A rapid method for determining the salinity of water is to measure its electrical conductivity. Pure water conducts very little electric current, but water containing dissolved salt does; the electrical conductivity (EC) increases proportionally with the increase in salt content of the water. Electrical conductivity measurements are usually reported in millimhos per centimeter at 25° Centigrade. In most instances, 1 millimho is equivalent to 640 parts per million (p.p.m.) of salts in solution. Consult your county agent, the Soil Conservation Service technicians, or State agricultural experiment station representatives for assistance in determining the salt content of your water.

How Much Brackish Water Can a Grower Use?

The amount of brackish water that can be used depends on the salt concentration of the water, the number of irrigations between leaching rains, the salt tolerance of the crop, and the salt content of the soil before irrigation. A guide, giving the number of permissible irrigations of water of varying salt concentrations for crops in the three salt-tolerance groups, is shown in table 1. This guide is based on two assumptions: (1) That there is no intervening rainfall of sufficient intensity to cause leaching; and (2) that there is no salt accumulation in the soil at the start of the irrigation period. If leaching rains occur between irrigations, the effect of the salt added is minimized. If salt has already accumulated in the soil, such as might occur when a fall crop is irrigated on land where brackish water had been applied on a spring crop, the soil should be tested for salt content. Accordingly, the recommendation should be modified.

TABLE 1.—*Permissible number of irrigations with brackish water between leaching rains for crops of different salt tolerance*

Irrigation water		Irrigations for crops having—		
Total salts	Electrical conductivity	Good salt tolerance	Moderate salt tolerance	Poor salt tolerance
Parts per million	*Millimhos per centimeter at 25° C.*	*Number*	*Number*	*Number*
640	1	------	15	7
1, 280	2	11	7	4
1, 920	3	7	5	2
2, 560	4	5	3	2
3, 200	5	4	2–3	1
3, 840	6	3	2	1
4, 480	7	2–3	1–2	------
5, 120	8	2	1	------

In most humid areas, normal winter rainfall usually is adequate to leach out any salt that accumulated from the use of brackish water during the preceding summer.

What Precautions Are Necessary in Using Brackish Water for Irrigation?

When brackish water is used for irrigation, it is necessary to know its salt content, or electrical conductivity. Where the salt concentration fluctuates, owing to seasonal or tidal changes that occur in certain rivers or streams, it is essential to know the actual salt content of the water at the time of irrigation. The salt tolerance of the crop grown must be considered in determining the suitability of a given brackish water for irrigation.

If soils have been irrigated previously with brackish water and the residual salt content is not known, consult your county agent or send a soil sample direct to the State soil testing laboratory. The laboratory will test the soil and recommend the number of irrigations with brackish water that can be used for the crop that is being grown. Soils to be irrigated with brackish water should have good internal drainage.

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